PUBLIC HEALTH REPORTS.

VOL. XXVII. MARCH 22, 1912. No. 12.

THE NECESSITY FOR SAFE WATER SUPPLIES IN THE CONTROL OF TYPHOID FEVER.[1]

By Allan J. McLaughlin, Passed Assistant Surgeon, Public Health and Marine-Hospital Service.

The excessive prevalence of typhoid fever in the United States has been characterized, and not without reason, as a national disgrace. Certainly that portion of our typhoid prevalence which is due to polluted water supplies is preventable, and our failure to prevent does not redound to our credit. The rather common use of sewage polluted water supplies without purification has been responsible for disaster in the shape of typhoid-fever epidemics in our cities, with a frequency not pleasant to contemplate. Such supplies untreated and unfiltered are exposed also to contamination from persons ill with or harboring the germs of Asiatic cholera should such persons gain access to the United States.

It is useless to expect that the dejecta of all persons ill with typhoid fever or cholera will be properly disinfected before reaching the sewers, especially if the contributor is a carrier who shows no signs of illness. It is evident that the surest and most prompt protection against water-borne diseases can be afforded in each case by proper treatment or filtration of the public water supplies. With cholera, we have only the menacing possibility, but with typhoid fever we have the actual existence of the disease in such a high rate of prevalence that the United States suffers seriously by comparison with other civilized countries.

The average American citizen displays toward sanitary problems a very dangerous apathy. It is difficult to arouse his interest in anything so well known as typhoid fever. Cholera or plague or any scourge which to him suggests a quick and mysterious death will awaken his instinct of self-preservation and arouse him to activity; not so typhoid fever. It has been all about him always, excites no terror, and is viewed indifferently as an inevitable visitation which comes every year and takes its toll from the community. He never asks himself, Is this visitation inevitable? Or, May not typhoid fever be prevented or reduced? Twenty deaths per 100,000 probably represent 200 cases of typhoid fever. Suppose 200 cases of Asiatic cholera occurred in any American city of 100,000 population, would not strenuous activity be displayed and very properly so for the eradication of the scourge? Although the case mortality rate of typhoid fever is lower than that of cholera, yet typhoid fever is transmissible

[1] Read Mar. 5, 1912, before the Illinois Water Supply Association at Urbana, Ill.

in more ways, is more expensive in its lingering course, and more disastrous in its sequelæ than Asiatic cholera. The mental attitude toward typhoid fever, displayed by many physicians and especially health officers, is scarcely more commendable. Their complacency in the face of typhoid fever rates of above 20 deaths annually per 100,000 population is difficult to explain. If the rate is below 20, many municipal officials are inclined to be satisfied with this rate as it is low compared with less fortunate cities.

What may be considered a low rate for typhoid fever? Table 1 shows the death rates per 100,000 population in 10 large European cities. The average for 10 years is given in the first column. The average for 5 years in the second column. The other columns show the rate for the individual years from 1906 to 1910, inclusive. The figures are given for 10 years to show that the low rates are consistent and not a mere coincidence. These 10 cities represent a population of about 15 million persons, and the average death rate per 100,000 population for the 10 years was only 3.4. The rates are gradually getting lower and the rate for these 10 cities combined, with a population of 15 millions, was only 2.5 in 1910.

TABLE 1.—*Annual death rates from typhoid fever per 100,000 population in 10 European cities.*

	Average for 10 years, 1901-1910.	Average for 5 years, 1901-1905.	1906	1907	1908	1909	1910
Stockholm	1.7	3	2	2	1	5	1.8
Christiania	2.4	3	4	2	2	1.7	1.6
Munich	2.5	4	2	3	3	1.9	1.4
Edinburgh	2.9	8	3	3	2	1.2	.3
Vienna	3.7	4	5	3	4	2.8	3.8
Hamburg	3.7	4	4	3	4	3.3	4.1
Berlin	3.8	4	4	4	4	4.2	2.9
Dresden	4.2	4	7	2	6	4.2	2.2
Copenhagen	4.5	8	4	2	7	2.7	3.6
London	4.7	8	6	4	5	2.2	3.3

Table 2 shows 15 other European cities which in 1909 and 1910 did not reach double figures in typhoid death rates per 100,000 population. These 15 cities represent a total population of over 9 millions. The average rate for the total population was only 5.3 in 1909 and 4.5 in 1910.

TABLE 2.—*Annual death rates from typhoid fever per 100,000 population in 15 other European cities.*

City.	1909	1910
Frankfort	1.5	0.9
Antwerp	1.0	2.3
Bristol	2.8	2.1
Nuremberg	2.6	....
Birmingham	5.0	3.9
Belfast	5.2	3.9
Lyon	5.8	4.4
Leeds	7.2	3.8
Liverpool	8.4	3.9
Sheffield	9.4	3.0
Rotterdam	6.4	6.5
Amsterdam	3.8	6.7
Paris	8.4	5.6
Bradford	4.3	9.2
Leipzig	8.3	7.5
Total average rate	5.3	4.5

Table 3 shows the remaining eight cities in northern Europe with populations in excess of 300,000. These eight cities have a population of about 7½ millions. Their total average rate for 1909 was 13.9, and for 1910, 15.6. These rates would be considered low in America, but the European officials consider the persistence of such rates to be a reflection.

TABLE 3.—*Annual death rates from typhoid fever per 100,000 popvlation in 8 other European cities.*

City.	1909	1910
Glasgow	12.5	6.4
Budapest	9.4	13.6
Brussels	7.4	16.1
Dublin	15.7	12.2
Manchester	13.9	10.8
Moscow	13.8	15.0
Warsaw	13.5	17.4
St. Petersburg	25.2	33.7
Total average	13.9	15.6

To recapitulate, in northern Europe the 33 principal cities, with an aggregate population of 31,500,000, had an average typhoid death rate per 100,000 population of 6.5 in 1909 and 1910. This includes such notorious typhoid centers as St. Petersburg, which had a rate of 33.7 in 1910. The rate in St. Petersburg is considered to be due to the water supply, which is partly filtered and partly raw Neva water.

It is clear that in cities which have had safe water supplies for a period of years the rate should not be above 5 per 100,000 unless some unusual condition exists, such as poor control of milk or lack of control over patients and carriers. Now let us compare typhoid-fever rates in American cities.

Table 4 shows our honor roll for 1909 and 1910. These are the typhoid-fever death rates among the 50 cities in the United States with more than 100,000 inhabitants. One city, Bridgeport, Conn., has a rate below 5. Three cities—Paterson, N. J., Cincinnati, Ohio, and Cambridge, Mass.—have rates below 10 per 100,000. Twenty-two other cities have rates of from 11 to 20 deaths per 100,000, and the remaining 24 cities have rates of from 20 to 86.

TABLE 4.—*Annual death rates from typhoid fever per 100,000 population in 50 cities of the United States having more than 100,000 inhabitants.*

City.	1909	1910
Birmingham, Ala	59.7	49.5
Los Angeles, Cal	16.1	14.2
Oakland, Cal	11.2	16.5
San Francisco, Cal	13.9	15.5
Denver, Colo	24.1	27.5
Bridgeport, Conn	9.0	4.9
New Haven, Conn	20.5	17.9
Washington, D. C	34.3	23.2
Atlanta, Ga	50.6	50.1
Chicago, Ill	12.6	13.7
Indianapolis, Ind	22.3	28.5
Louisville, Ky	45.0	31.7
New Orleans, La	28.4	31.5
Baltimore, Md	24.9	42.0
Boston, Mass	13.8	11.3
Cambridge, Mass	7.7	9.5
Fall River, Mass	21.3	15.0

TABLE 4.—*Annual death rate from typhoid fever per 100,000 population in 50 cities of the United States having more than 100,000 inhabitants*—Continued.

City.	1909	1910
Lowell, Mass.	10.5	19.7
Worcester, Mass.	8.4	15.7
Detroit, Mich.	20.5	23.0
Grand Rapids Mich.	17.2	28.3
Minneapolis, Minn.	21.0	58.7
St. Paul, Minn.	18.9	19.5
Kansas City, Mo.	29.3	54.4
St. Louis, Mo.	16.2	14.9
Omaha, Nebr.	36.8	86.7
Jersey City, N. J.	8.8	11.5
Newark, N. J.	11.9	13.1
Paterson, N. J.	9.7	7.1
Albany, N. Y.	19.0	14.0
Buffalo, N. Y.	23.8	20.4
New York, N. Y.	12.1	11.6
Rochester, N. Y.	9.4	13.7
Syracuse, N. Y.	11.2	28.2
Cincinnati, Ohio.	13.3	8.8
Cleveland, Ohio.	13.3	17.9
Columbus, Ohio.	19.6	18.1
Dayton, Ohio.	26.9	21.4
Toledo, Ohio.	41.7	37.2
Portland, Oreg.	22.0	22.4
Philadelphia, Pa.	22.3	17.5
Pittsburgh, Pa.	24.6	27.8
Scranton, Pa.	16.4	16.9
Providence, R. I.	11.4	17.9
Memphis, Tenn.	48.8	27.4
Nashville, Tenn.	52.0	48.9
Richmond, Va.	24.1	21.9
Seattle, Wash.	23.8	14.2
Spokane, Wash.	43.2	45.4
Milwaukee, Wis.	21.4	45.7

These 50 registration cities in the United States have an aggregate population of over 20,000,000. The aggregate typhoid death rate in these cities for 1910 was 25 per 100,000 inhabitants.

Unit of comparison.	Aggregate population.	Deaths per 100,000 from typhoid fever, 1910.
33 principal European cities in Russia, Sweden, Norway, Austria-Hungary, Germany, Denmark, France, Belgium, Holland, England, Scotland, and Ireland.	31,500,000	6.5
50 American cities of 100,000 inhabitants or over	20,250,000	25.0
Excess of deaths from typhoid fever in American cities.	....	18.5

So that on an average in every 100,000 population we had, compared with European results, 18.5 deaths and at least 180 cases of typhoid fever which should never have occurred. A conservative estimate for 1910 will place the deaths from typhoid fever above 25,000. When we consider that the smaller cities in America have in general higher rates than the larger, that the rural typhoid is high and in many sections higher than the urban, that in the sections not included in the registration area sanitary conditions are probably worse and typhoid fever rates higher than within the area, we are forced to conclude that a general rate of 25 is probably below the actual deaths from typhoid fever per 100,000 population in the entire United States.

The excess of 18 deaths per 100,000 in the urban population alone shows that we have had in the 50 cities mentioned above, at

least, 3,600 deaths and probably 36,000 cases of typhoid fever which were preventable and should never have occurred. For the whole United States the number of cases for each year preventable by methods within our grasp would probably reach 175,000, and the deaths so avoided would total 16,200. In 1909 there were more cases of typhoid fever in the United States than there were cases of plague in India in spite of the fact that India's population is two and one-half times that of the United States.

From January, 1907, to October, 1911, there occurred in Russia 283,684 cases of Asiatic cholera. This included the appalling epidemic of 1910. According to a conservative estimate there occurred in the United States during the same period one million and a quarter cases of typhoid fever, or more than 4 cases of typhoid fever in the United States for every case of cholera in Russia. We heard a great deal of the terrible ravages of cholera in Italy in 1910–11; yet in these two years there occurred in Italy about 16,000 cases of cholera, with about 6,000 deaths, and in the United States in the same period we had more than a half million cases of typhoid fever and 50,000 deaths.

We are accustomed to speak of certain countries as pest ridden, and a residence in them or even a brief visit is considered with apprehension. But do we consider the prevalence of typhoid fever in our own country with sufficient seriousness? The annual 25,000 deaths from typhoid fever do not represent our total loss. At a conservative estimate they are accompanied by a quarter of a million of cases of the disease each year.

These cases represent an average illness for each individual of four weeks and probably six or eight weeks enforced abstinence from any gainful occupation. The economic loss is appalling, and, computing the value of the lives lost to the community, the cost of medical attendance and hospital care, the loss of earning capacity for many weeks, the decreased earning capacity and impaired efficiency due to sequelæ, would reach a sum of not less than $100,000,000 annually.

To understand fully the menace of typhoid fever, one must remember that it can not be prevented by ordinary personal cleanliness as typhus fever may be prevented, and is not confined to the poor and dirty, but reaches all classes.

It is not something we have in childhood and consign to history, as scarlet fever or measles, but a disease which attacks the most robust adult individuals during the period of their greatest activity and their greatest economic value to the community. Typhoid fever is a disease against which the individual is helpless,[1] and protection of the individual can be effected only by sanitary control of the entire food and drink supply and the sanitary disposal of human excreta.

Time will not permit the discussion of the whole problem of typhoid-fever transmission, and I shall confine myself to the water-borne typhoid solely. This is done with a full appreciation of the great importance of the other factors in typhoid transmission, viz, milk, control of patients and carriers, contact, flies, and rural typhoid.

No single measure in reducing typhoid fever on a large scale approaches the effect of substituting a safe for a polluted water supply. As an instance of this wholesale saving of human life, the reduction

[1] Vaccination against typhoid protects the individual in the great majority of cases. As a general means of protection of the civilian population, it is not likely to prove practicable, however, although of immense advantage in protecting military units against typhoid where compulsory vaccination is feasible.

of typhoid fever in Pittsburgh may be cited. Since the installation of the Pittsburgh plants there has been an annual saving in the city of 400 lives from typhoid fever alone. Installation of safe water supplies in America has not always produced brilliant results, but the failure to reach the low figures attained by the Germans is due principally to three things: First, failure to supply pure water to all; second, imported cases, usually from communities which are typhoid centers; third, existence of insanitary conditions, such as contaminated wells, outdoor privies, and lack of control over milk and excreta.

As an instance of high rate due to failure to furnish filtered water to all the people, the experience of Pittsburgh is interesting. The filter plant in Pittsburgh was first put in operation November, 1907. But a small portion of filtered water was supplied at first and this was mixed with the unfiltered supply. The amount of water filtered was increased until October, 1908, when the supply of that part of the city between the rivers—about three-fifths of the total population—was filtered.

The south side, a little less than one-fifth of the entire population, was supplied with filtered water in March, 1909. The former city of Allegheny, recently annexed, is not yet supplied with filtered water. This part of the city includes a population of about one-fourth of the entire city.

There was a remarkable decrease of typhoid fever in Pittsburgh progressively coincident with the increase of area supplied with filtered water. In spite of all this remarkable reduction two points stand out prominently: First, the rate is still high (1910), and, second, the seasonal distribution suggests water as a prime factor. Explanation of these two points is furnished by a study of the cases as shown in Table 5, from which it is clear that water was responsible for the high rate, and that this high rate was due entirely to the abnormal rate in wards 21 to 27, inclusive.

TABLE 5.—*Typhoid-fever deaths by wards, Pittsburgh, Pa., 1910.*[1]

	Population.	Typhoid deaths.		Population.	Typhoid deaths.
Ward 1	11,623	3	Ward 15	20,141	3
Ward 2	14,386	1	Ward 16	20,833	1
Ward 3	26,462	3	Ward 17	25,213	3
Ward 4	25,055	11	Ward 18	17,994	1
Ward 5	24,495	2	Ward 19	23,482	3
Ward 6	26,261	3	Ward 20	18,648	2
Ward 7	13,263	1	Ward 21	22,506	11
Ward 8	18,204	0	Ward 22	15,716	9
Ward 9	17,795	6	Ward 23	21,799	13
Ward 10	21,205	3	Ward 24	17,354	6
Ward 11	17,066	2	Ward 25	16,037	5
Ward 12	22,342	2	Ward 26	15,291	6
Ward 13	24,080	2	Ward 27	23,580	12
Ward 14	13,074	1			

[1] These figures were furnished by the health department of the city of Pittsburgh.

Total population of Pittsburgh	533,905
Total deaths typhoid fever	115
Death rate per 100,000, entire city	21.3
Death rate per 100,000, wards 1 to 20	13.4
Death rate per 100,000, wards 21 to 27	46.9

Wards 1 to 20 were supplied with filtered water. The aggregate population of these 20 wards was 401,622. The typhoid-fever death

rate per 100,000 in 1910 was 13.4. Wards 21 to 27 comprise the old city of Allegheny and have a total population of 132,283. This section received unfiltered water. The typhoid-fever death rate per 100,000 in this section in 1910 was 46.9.

The absolute necessity of a safe water supply—and by "safe" a supply is meant which is safe 365 days in the year—in seeking to rid ourselves of the odium of water-borne typhoid, is obvious. The installation of such a supply, however, has another powerful effect upon the typhoid-fever rate. The existence of a pure public water supply makes possible the elimination of the dangerous shallow well and filthy yard privy. With a contaminated or unsightly public supply a vigorous campaign against the insanitary privy and contaminated well is impossible. The householder is as a rule unwilling to close his well and connect his premises with the public water mains unless the city water appears to be better than that obtained from the well. When water connections have once been made, water closets or other suitable toilet facilities are usually installed as a matter of convenience and the yard privy is no longer needed and its use, therefore, is discontinued.

The conditions which make disaster possible where the source of public water supply is polluted are two, viz:

1. Failure to purify.
2. Inefficiency of the purification.

The failure to install a purification plant is usually due to an undue confidence in a water supply which is safe "most of the time." It is difficult for some officials to understand, without a severe lesson, that it is not sufficient to have a water supply that is safe for 360 or 361 days in the year, and to these officials it seems scarcely justifiable to require expensive purification for the sake of the four or five days in the year during which, due to weather conditions, pollution may take place. Such a supply, with a favorably placed intake, may escape pollution for more than a year. There was no evidence of serious pollution of the water supply of the city of Erie during the year 1909, yet the appalling disaster of January and February, 1911, showed that pollution could take place under certain weather conditions.

There is also too much confidence placed in unfiltered surface supplies from inhabited watersheds. Even where there is alleged control of the watershed and ample storage, pollution may occur. In regard to unfiltered surface supplies the need of bacteriologic control is very evident. Dangerous pollution may be present only for a few days or for a few hours. This is most likely to be disastrous in time of drought or low water. At such times the diluting effect of the inflow and the purifying effect of storage are both reduced to the minimum. The bacterial count per cubic centimeter is valuable, but the quantitative estimation of B. coli is of far greater importance. A low count does not necessarily imply a safe water, but a low count, coupled with absence of B. coli, may be considered an index of safety.

The typhoid epidemic in Baltimore [1] in 1910 was coincident with a prolonged drought. The run-off from the watershed of the Gunpowder River was reduced to the minimum. The sewage pollution was thus concentrated and gross pollution was evident upon bacteriologic examination. B. coli was frequently found in 0.1 of a cubic centimeter, and sometimes in 0.01 cubic centimeter samples. When

[1] Ford, Wm. W., and Watson, E. M. Bulletin Johns Hopkins Hospital, October, 1911.

the run-off increased, affording greater dilution and increased storage, the water returned to normal and the typhoid fever dropped to a minimum.

In Europe surface supplies are almost invariably filtered, and eventually such supplies in America will be treated or filtered.

Poor filter efficiency is often responsible for disaster in the shape of typhoid outbreaks and may be due to several causes. The slow sand type may give poor filter efficiency when sufficient extra units are lacking, necessitating excessive rates and placing of "green" filters in service. Excessive rates, too little coagulant, insufficient sedimentation capacity, and insufficient storage are common operating and structural faults of the mechanical type. Sometimes a properly constructed plant is struggling with a raw water which has a high bacterial content and even with fair filter efficiency yields an unsafe effluent. Probably the greatest single cause of a poor effluent from filter plants is inefficient operation by unskilled men. It is absolutely essential for good results that bacteriologic examination, including B. coli estimation, be made at least once daily, and in slow sand plants from each unit separately.

The man in charge must be able to do this. In mechanical filter plants or with hypochlorite plants he must also have the necessary skill to adjust his chemicals with nicety according to the changes in the raw water. With such a man in charge of a properly constructed plant a safe effluent is assured at all times. When struggling with a bad raw water, he will use hypochlorite as an adjuvant with good results. He will study the peculiarities and fluctuations of the constituents of the raw water and adjust his treatment accordingly.

The most serious defect in sanitary control of our water supplies is the lack of proper daily bacteriologic examination of the water and quantitative estimation of the B. coli content. In some of the lake cities there is proper daily bacteriologic examination of the water supply, but in many of them there is either an imperfect examination or none at all. One city with a slow sand filter plant of three units and a consumption equal to the safe filter capacity of the beds operates these without rest, putting the units in service "green" and with an occasional examination of the water once or twice a month. As a result this city in 1910 had a typhoid-fever death rate of over 300 per 100,000. One large city using unfiltered lake water is so sure that the water is pure that examination is made only occasionally. One of the largest lake cities using an unfiltered supply exposed to sewage pollution makes a bacterial count daily, but restricts its effort to detect sewage pollution to the antiquated and indefinite test of inoculating a guinea pig occasionally with a small portion of a broth culture.

It is the plain duty of a municipality to provide its citizens with pure water. It is not sufficient to warn against a supply as dangerous and advise its use only for fire, lawn sprinkling, or factory purposes, as at Flint or Saginaw. There are many people in every city who are like children and must be protected even against themselves. The lazy, poor, and ignorant will drink and use the polluted public supply from a convenient tap rather than travel a considerable distance to a pump or buy bottled water which they can ill afford. Neither is it sufficient to have a safe supply for 360 days out of the year, warning the people to boil the water on the other 5 days. The notice to boil

the water is based on bacteriologic findings which are 24 hours late. The notice is often ineffective, and by some ignored.

The factors affecting sewage pollution of a water supply and which determine the relative danger to be anticipated from such pollution are: The amount of polluting material, the presence of pathogenic organisms, the time of transit from the source of pollution to the waterworks intake, and the amount of water available for dilution.

Provided that the amount of polluting material is considerable, that typhoid fever is prevalent on the watershed, and that the time of transit is within the bounds of time deemed necessary for the natural death of bacteria, pollution of the intake will take place. The last factor, the amount of dilution, will determine the intensity of the pollution. If the polluting material is great in amount or if a swift current cuts down the time of transit, prevents sedimentation, and retards dilution, then gross pollution results.

With a dilute pollution one need not expect a great explosive outbreak, but many cases of typhoid may result, especially following floods and rains. Often in the absence of explosive outbreaks in the winter or spring months it will be demonstrable that too many deaths from typhoid fever occur in the first half of the year. On the other hand, it is reasonable to suppose that the dilute infection may be responsible for many scattered cases which can not be traced to water. These cases may not appear in sufficient numbers in any particular month to be remarkable or they may be obscured by occurring in the months when typhoid fever is accepted as an inevitable visitation.

Water may be responsible for many cases of typhoid when it is impossible to prove the case against it. We are able to fix the guilt on the water supply only in massive outbreaks of explosive character, but smaller doses of pollution can be responsible for smaller outbreaks of many cases spaced over a long period without any hope of proving this causation.

When cities have a public water supply polluted by sewage, or admittedly exposed to pollution, the obvious thing to do is to filter or treat the water and protect the public from infection. Unfortunately there is a deplorable tendency to abuse the town above and to spend years in an effort to compel (usually without legal process) sewage treatment in the offending municipality. In other cities where the pollution is due to their own sewage, years are lost in the discussion of methods of sewage purification, while the dangerous untreated and unfiltered water is furnished to the citizens.

In regard to sewage disposal it must be remembered that no general rule can be formulated which will cover with justice every case. Each municipality becomes a separate problem and local conditions must be studied. Remedies for correction of improper sewage disposal will differ according to the local conditions. Even if all the sewage from our large cities and towns was prevented from reaching the lakes and rivers, it would be impossible to prevent pollution from reaching these waterways in times of storm and flood, so that sewage disposal even carried to the degree of sterilizing the effluent does not give us a substitute for water filtration or treatment. While it is impracticable to prevent pollution of the Great Lakes, it is possible and imperatively necessary that such pollution be controlled and kept within safe bounds. It would be very foolish from an economic

standpoint not to avail ourselves of the cheapest and simplest method of sewage disposal, viz, disposal by dilution, provided that this may be done without danger to the water supplies of other communities and without putting an unreasonable burden and excessive responsibility upon the filter plants of those communities. The point to which this method of disposal may be permitted must be determined by local conditions. There is a crying need in the United States for official standards of drinking water.

In view of the fact that bacterial counts may be low in a comparatively dangerous water, and sometimes a high count might be found in water containing no evidence of fecal bacteria, the colon estimation is of primary importance in judging the character of a raw water. There should be standards for the permissible colon content of raw water. These should be fixed after careful study of the ability of filter plants and other processes to remove colon and other fecal bacteria. These standards for raw water and for filtered or treated water would enable us to strike a balance between sewage purification and treatment of water, and to determine the degree of sewage purification necessary to assure a raw water of reasonable quality at a given point. These standards would also mark the extent to which disposal of sewage by simple dilution might be permitted with safety. As a general proposition, it is cheaper to treat drinking water than to purify sewage. The economic side of the question must be considered. How far is it necessary to carry the treatment of sewage as an adjunct to water purifications? The balance between these two powerful agencies in the protection of the public health must be struck, and, as intimated above, this must be done separately for each local problem and no definite rule for the relation of these agencies can be made. These should fix the permissible number of bacteria in both raw and filtered or treated water. I do not care to attempt to fix such a standard, but, in my opinion, the bacterial count in raw water from the Great Lakes should not exceed 5,000 per cubic centimeter at any time and should not average above 1,000. Filtered or treated water should not contain more than 100 organisms per cubic centimeter at any time and the average should be 20 or under.

These sewage problems are often difficult of solution, present great engineering difficulties, and necessitate the expenditure of large sums of money. This means that much time must elapse before the proper method is selected and a great deal more time will pass before the works are completed. In the end though necessary, the sewage purification does not remove all pollution, and treatment of the water supply is still a necessity after the sewage-disposal plant is in operation. On the other hand, the dangerous public water supply is a simpler proposition. Immediate protection can be afforded by treating with "hypochlorite," using a temporary plant until the method to be finally adopted is decided upon. In a word, there is every excuse for deliberation and reasonable delay in settling the sewage-disposal problems, while there is no excuse whatever for any municipal government to delay in applying the remedy which protects immediately, viz, treatment or filtration of the public water supply. Sewage-disposal measures for improving the quality of the raw water, for preventing its deterioration, or for other reasons may be undertaken when necessary and feasible.

SUMMARY.

1. In the prevention of typhoid fever there is a necessity for safe water supplies for 365 days in the year.
2. Unfiltered surface supplies may be exposed to a dangerous pollution for a few days or even for a few hours only.
3. Supplies derived by impounding surface waters and which depend upon storage alone to nullify the pollution of an inhabited watershed may be very dangerous in periods of drought and low water. The proportion of pollution is relatively greater at such times and the time of storage is greatly reduced.
4. Purification, whether by storage, filtration, or chemical treatment, must be efficient at all times, and this can not be assured without daily bacteriologic control.
5. It is essential that a daily quantitative estimation of B. coli be made, as a low bacterial count does not necessarily mean a safe water without absence of B. coli.
6. There is a necessity for close supervision of municipal plants by the State to correct structural and operative defects and insure a safe water at all times.
7. Bacteriologic control and State supervision would insure cleaning when necessary and should prevent the putting in service of slow sand filters before the *Schmutzdecke* is ripe.
8. In order to control typhoid fever and eliminate water-borne typhoid it is not sufficient alone to have a purification plant. In addition the purification must be efficient and the purified water must be available in all parts of the city.
9. The danger of dual water supplies is apparent, especially if the polluted supply is easy of access and the safe supply difficult to reach or expensive.
10. In protecting the public health, purification of the public water supply is usually primary and sewage disposal secondary, but often a judicious adjustment of the two agencies is necessary especially for economic reasons. Sewage disposal will rarely if ever make a sewage-polluted water supply absolutely safe, but is often an aid and sometimes a necessity to furnishing a reasonably good raw water for the purification plant.

A "PUBLIC-HEALTH WEEK" IN BALTIMORE.

Under the auspicies of the Medical and Chirurgical Faculty of Maryland there was observed from February 19 to 26 a "public-health week," which included an exhibition and lectures daily on public-health subjects.

Several lectures were presented each evening to popular audiences assembled in the lecture room of the building of the above-mentioned faculty, and space was provided in the same building for housing the exhibit.

On request, the Public Health and Marine-Hospital Service sent exhibits, which included a number of models used in previous exhibits and certain charts and maps. The models were as follows:

1. Corner of rat-infested kitchen, with insanitary garbage barrel.
2. House and surroundings, showing rat infestation.